Journal of Solar Energy Engineering

Guest Editorial

A Message From the Guest Editor

This special issue of the *Journal of Solar Energy Engineering* is dedicated to solar energy research activities in Asia. It contains 11 papers from China, Taiwan, Korea, and Japan. There are three major paths along which solar radiation can be converted to electricity or chemical fuels:

(1) the thermal path to produce electricity (CSP) or chemical fuels (thermochemical cycle, etc.),
(2) the photovoltaic path to produce electricity (solar cell), and
(3) the photochemical path to produce chemical fuels (photocatalysis).

In this special issue, three papers belong to the path (1), six papers to the path (2), and two papers to the path (3).

The thermal path to generate electricity is referred as "concentrated solar power" or CSP. The greatly insolated "sunbelt" regions of the world include large Asian regions in China and India as well as the southwestern United States, southern Europe, Australia, the MENA regions, etc. There have been no commercialized CSP plants in such Asian sunbelt regions yet, however, several CSP plant demonstration projects are currently ongoing. In this special issue, the readers will learn that a landmark 1 MW solar tower demonstration plant is currently being built in China (Wang et al.). Also, a 200 kW solar tower demonstration plant with air receiver is planned to be built in Korea.

The conversion of solar radiation to chemical fuels has the advantage of producing transportable and long-term storable energy carriers. This is important because energy demand is rarely synchronous or geographically matched to incident solar radiation. Especially, the conversion to clean hydrogen via water splitting is an engineering challenge. There are two major chemical paths from solar radiation to hydrogen—one is the thermochemical path and the other is the photochemical path. In the thermochemical path, concentrated solar high-temperature heat above 1000°C is converted to hydrogen via a multi-step water-splitting cycle. In Japan, a two-step thermochemical water splitting cycle using a metal-oxide redox pair has been developed. Two different solar water splitting reactors are now being developed (Gokon et al. and Kaneko et al.). In the photochemical path, a photon flux is used to directly drive quantum processes. Since Honda and Fujishima reported the potential of converting light energy to hydrogen using a TiO_2 photoelectrochemical cell, many semiconductor materials have been investigated for photochemical water splitting. For effective conversion of solar radiation, water splitting under visible light is required. This special issue includes a paper on visible-light-driven photocatalysts (Iwase et al.) and a paper on dye-modified catalyst (Hagiwara et al.) for water splitting.

Japan is one of the world leaders in the development of "photovoltaics." Recently, great interest has been paid to the dye-sensitized solar cell because of its low manufacturing cost, environmentally benign properties, and efficiency. Active research teams in this field have contributed to three papers from Japan (Ono et al., Uzaki et al., and Kitamura et al.) for this special issue as well as one paper from Korea (Lee et al.) and one from Taiwan (Tsui et al.). The polymer solar cell is also a very attractive candidate due to its low cost, capability to flexible devices, etc. Chen et al. present the novel research results of their tandem polymer solar cell.

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